Independent Campus on Industrial Engineering Undergraduate Program

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Independent Campus on Industrial Engineering Undergraduate Program in Indonesia: A Delphi Method

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Abstract - **The industrial engineering department needs to evaluate graduates who can adapt their expertise to the needs of the industry. The purpose of this study is to assess graduate skills through program educational objectives (PEO) and learning outcomes (LO) and propose an undergraduate student internship program by adopting the concept of an independent campus in Indonesia. Moreover, it also uses a three-round the Delphi method through the in-depth interviews with 128 alumni in 100 industries, focus group discussion with ten experts, and validation from the panelist consist of practitioner and academician. Findings presented that 3 PEO and 14 LO still relevant based on the industrial requirement. Then, this study found that there were two types of internship programs consisting of 18 skills of the internship program in the industry and 14 skills of the entrepreneurship program. The paper guides the industrial engineering department in charge of an undergraduate student internship program through a Delphi method.**

Keywords - **Delphi method, industrial engineering department, internship program, independent campus**

I. INTRODUCTION

One of the goals of collaboration between industry and universities is to increase the number of university graduates working in the industry. Universities are institutions that have strategic roles and positions in achieving educational goals to create quality human resources. This human resource is equipped through several activities at the University, including work creation, identification of interests and talents, enhancement of creativity, and skills training [1]. Nevertheless, to be accepted in the industry, a graduate at a university must be able to adjust his skills to the needs of the manufacturing or service industry. Besides, the industry's need for human resources is dynamic so that graduates are required to explore various sciences and skills that are in line with changing times.

The Indonesian government is continuously improving the quality of education at universities through several breakthroughs. Independent campus is a new concept to encourage universities to give undergraduate student opportunities to prepare themselves before working in the industry. Through this curriculum, students are given a choice of programs according to their interests and goals. University management requires to prepare the implementation of the concept of an independent campus in each department following its needs.

A study described that scientific Industrial Engineering is an engineering profession that has knowledge and skills in the fields of mathematics, physics, and social science. It able to optimize systems or organizations by developing, improving, and implementing integrated systems of people, money, knowledge, information, equipment, energy, and materials to specify, predict and evaluate the results obtained from systems and processes [2]. To adopt the concept of an independent campus, this department needs to evaluate the curriculum for learning at universities. There are many parties involved in the preparation of the curriculum at University, including academics, practitioners, and government [3]. Thus, the role of various parties in compiling a learning curriculum can adjust graduates' skills to apply to the industry.

The purpose of this study is to develop an undergraduate student internship program by adopting the concept of an independent campus in the industrial engineering department to facilitate students preparing themselves to work in the industry. This case study was done in the Industrial Engineering Department at UIN Sultan Syarif Kasim in Indonesia, which has established for 20 years. This research needs to adopt the Delphi method with the involvement of experts according to their expertise and experience. A study used the Delphi method to improve the curriculum at the campus because of this approachable to an in-depth interview with experts [4].

II. METHODOLOGY

This research needs several experts or industry players to achieve these objectives of the study. In-depth interviews are needed through a qualitative approach using the Delphi method as a decision-making process involving several experts on the development of education. The research used the Delphi method in educational research, which proved that it was useful in forming guidelines, standards, and predicting trends in the campus environment [5]. Furthermore, data analysis was carried out through the a-three round Delphi method, including The e-Delphi in the form of questionnaires, focus group discussion, and validation from the panelist. To analysis this data, it studied through qualitative data using Nvivo software.

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Round 1 - The e-Delphi: The initial stage evaluates the existing competencies of graduates in this department through the distribution of questionnaires to alumni who have worked in several industries including manufacturing, process industry, oil and gas, public organizations, plantations, construction, and so on in April-June 2020. Alumni are directed to evaluate the PEO and LO in the curriculum of this study program. Currently, this study program has 3 PEO and 14 LO in its curriculum framework. In data collection, this study distributed the instrument to all alumni who become respondents in this study. Probability sampling with simple random sampling was adopted. A study stated that simple random sampling could be used to generalize the perception of members of the population to an event [6].

Round 2 - Focus Group Discussion (FGD): Results of PEO and LO in the industrial engineering department are discussed in focus group discussions to explore more deeply the skills that industry needs at this time. The FGD approach is carried out through face to face interviews with experts who are followed by industry players and academics. A study stated that in-depth interviews at FGDs obtain more information and can complement each other's data from existing experts [7]. Interview questions direct experts to answer according to work experience based on issues related to the PEO and LO. Then, the results of PEO and LO are comprehensively validated to obtain industry-recommended skills for implementing undergraduate student internship programs.

Round 3 - validation by the panelists: The results of the FGD are validated by converting statements into interview transcripts. Then this is analyzed through a content-analyzed approach to infer the skills needed by the industry. Content -analyzed can generalize the results of interviews into several points or synopsis of activities [8]. The results of the content-analyzed got several skill recommendations for the University to apply to the internship program. The next stage validated by the panelists conducted by academics in the industrial engineering department and industry practitioners following the results of the focus group discussion. The validation process is carried out by adopting Bloom's taxonomy, which describes graduate skills with cognitive domains for undergraduate students. The research explained that skill of undergraduate student focus on comprehension and application [9].

III. RESULTS

This study obtained 128 alumni with different fields of industry work and work experience who work at 100 industries with 22 business categories in Indonesia. The sample size is taken from those who work with long working experience ranging from 1 year to more than nine years. The profile of respondents in this study can be seen in Fig 1 and Fig 2. The tracking results show that alumni involved in this study predominantly work in the process and manufacturing industries. Then, the duration of work experience shows 89% of alumni in the first five years working in the industrial sector.

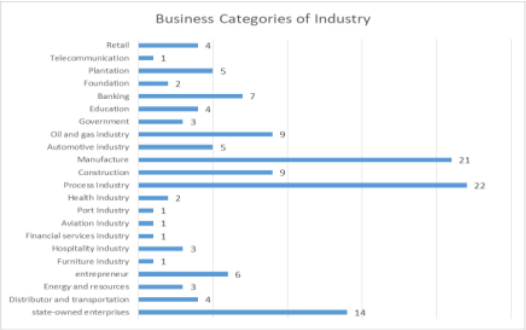

Fig. 1. Number of the business category of industry

Fig. 2. Number of alumni based on the duration of working experience

A. Evaluation of Program Educational Objectives (PEO) and Learning Outcomes (LO)

The results of this study found that Three (3) PEO and Fourteen (14) LO in the industrial engineering department are still relevant, and this can be seen in Table 1 and Table 2. PEO1 and PEO2 are categorized as very important ($\geqslant$ 3.5). Problem-solving in the industry is the most important achievement because the industry has a complexity of problems that must be solved, including production, operations, and others. To solve a problem in the industry, this can be done by defining the problem, determining the leading cause of a problem, finding alternative strategies for solving the problem and implementing the solution until the problem is solved. The industry also requires practical problem solving by workers with tenacious, hardworking, and unyielding character to increase productivity. Thus, repairing industrial systems can solve problems in a tactical, strategic, and operational manner. PEO3 is considered important (2.5 $\leqslant$ average <3.5) because each industry has different approaches or methods for managing business processes effectively and efficiently.

Moreover, the results of a survey of LO are 6 points of very important ($\geqslant$ 3.5). LO12 is the highest average value, which explains "the ability to work together in a workgroup." Cooperation in a team becomes a necessity in realizing success and improving industrial performance. Cooperation in a team can also encourage workers to work together in accelerating the achievement of industrial organization goals. LO11 and LO3 are also very needed because professional responsibility and mastery of communication and technology are the top priority skills required by the industry. There are 8 points

of LO categorized as important (2.5 ⩽ average <3.5). One of them is mastering the principles and current issues in economic, social, ecology in general. It is intended that decisions made by the industry able to adjust or consider the latest issues. LO1 has the lowest average value but is still regarded as important.

B. The internship program

The focus group discussion (FGD) was attended by ten experts from different fields in Indonesia. Profile of ten experts as evaluators to formulate skills in this internship program can be seen in table 3. The results of the FGD formulated the skills of graduates of the industrial engineering department to be grouped into internship programs in industry and entrepreneurship programs. Thus, this activity was successful in formulating some of the skills needed by the internship program through a content-analyzed approach. The initial recommendation of the FGD was to produce 19 skills for internship programs in the industry and 16 skills for an entrepreneurship program. Then, the panelist's validation was carried out with further discussion to academics and confirmation to industry practitioners for the implementation of this program. Thus, an internship program in the industry for students obtained 18 proposed skills to be applied. The skill of identifying job descriptions in the industry is considered inappropriate and needs to be eliminated because the industry has done a task breakdown for every employee. Then the entrepreneurship program obtained 14 skill proposals. There are two skills in the entrepreneurship program being eliminated, including planning demand uncertainty and designing networking in business processes. This skill is considered inappropriate for the entrepreneurship program because it requires a long process to implement. Besides, the proposed skill for both programs is integrated with the learning method using Bloom's taxonomy. It is intended that the undergraduate program can adjust to the level of the learning process. Students can improve the skills needed by choosing one of these internship programs for one year of study outside the campus. Table 4 and Table 5 are the results of an internship program in the industry and entrepreneurship program.

IV. DISCUSSION

Currently, the skills of graduates in the industrial engineering department are still relevant to industry needs. It can be proven from the results of the evaluation of 3 PEO and 14 LO that shows are still above average or "important." PEO2 is the highest value that defines the ability to solve industrial organization problems by designing innovative integrated systems to improve performance. Alumni believe that integrated system design is a primary requirement by the industry for graduates of the industrial engineering department. It is an ability to provide problem-solvers for industrial systems. A study state that the essential knowledge of industrial engineering is to design a mechanism for efficient integrated systems [10]. Learning outcomes in this case study show that LO12 is the highest value, which explains that graduates must be able to collaborate in a workgroup. Problem-solving in the industry involves many entities. Thus, graduates must be able to work in teams with rapid adaptation to achieve industry goals. A study stated that teamwork is one of the necessary skills of industrial engineering because resource management requires the cooperation of entities within a system [11].

This study found proposed skills for students in an internship program in the industry and entrepreneurship program. This skill can be chosen and adapted to the needs of the work environment. Implementation, students will be given a project for one year based on the direction of their supervisor. Then this project will be broken down based on the skills needed following the selected program. Thus, the skills acquired by students during the internship program in line with the curriculum in the industrial engineering department. There are eighteen (18) proposed skills for Internship programs in the industry. These results support the previous study related to strengthening the skills of graduates in industrial engineering. This study obtained the same results [12-14] related to the skills needed in the scientific fields of industrial engineering in various countries. Then, the entrepreneurship program obtained fourteen (14) skill proposals based on the concept of an independent campus. Previous studies have shown that there are several skills in this entrepreneurship that can be used for the learning process at the University [16-18].

V. CONCLUSION

This research has shown that the skills of graduates in the Industrial Engineering Department at UIN Sultan Syarif Kasim in Indonesia are relevant to industry needs. Moreover, the proposed internship program in industry and entrepreneurship programs can strengthen the curriculum in this department to prepare graduates to be accepted to work in the industry. However, for the implementation of the proposed internship program, university managers need to collaborate with several agencies or industries to attach students. Then, this proposal must be further discussed in industries with different business process characteristics to explore the needs of skills in a particular sector. Thus, further research is recommended to determine the scheme of industrial cooperation with the industrial engineering department. It aims to make good feedback on the implementation of this activity. Then, it further discussed with the government to become public policy in helping workers be accepted more in the industry.

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Table 1
PROGRAM EDUCATIONAL OBJECTIVES

No	ID	Program Educational Objectives	Mean rating	Rank
1	PEO1	Graduates are expected to attain in building industrial organizations with tenacious, hardworking and unyielding character to increase productivity	3.547	2
2	PEO2	Graduates are expected to attain in solving the problems of industrial organizations by designing innovative integrated systems to improve performance	3.563	1
3	PEO3	Graduates are expected to attain in running industry organizations with using the method in the Industrial Engineering consistently and sustainably	3.477	3

Notes: Scale 1 – not important; 2 - somewhat important; 3 - important, 4 - very important.

Table 2
LEARNING OUTCOMES

No	ID	Learning Outcomes	Mean rating	Rank
1	LO1	an ability to understand the theoretical concepts of engineering fundamentals, engineering mathematics, engineering science, and engineering design to solve industrial engineering problems	3.242	14
2	LO2	an ability to apply the principles and techniques of system design integrated with the system approach	3.492	7
3	LO3	an ability to apply the knowledge about communication techniques and the technological developments	3.641	3
4	LO4	an ability to understand contemporary issues in economic, social, ecological generally	3.469	9
5	LO5	an ability to apply the knowledge mathematics, statistics, science and engineering analysis in an integrated system consisting of human, material, equipment, energy, and information	3.406	13
6	LO6	an ability to identify, formulate and analyze the industrial engineering problems based on analytic, computational or experimental approaches	3.406	12
7	LO7	an ability to design integrated systems according to health standards and environmental safety by considering aspects of performance, implementation, and sustainability based on economic, social and cultural factors	3.516	6
8	LO8	an ability to examine the industrial engineering problems by carrying out research, analysis, interpretation of	3.406	11

		data and synthesis of the information to provide solutions		
9	LO9	an ability to select resources and utilize information and computational technology for industrial engineers	3.422	10
10	LO10	an ability to communicate in foreign languages both in written and oral effectively	3.617	4
11	LO11	an ability to understand professional and ethical responsibility	3.672	2
12	LO12	an ability to work together in a workgroup	3.758	1
13	LO13	an ability to engage in a life-long learning	3.477	8
14	LO14	an ability to develop creative and innovative entrepreneurial skills	3.609	5

Notes: Scale 1 – not needed; 2 - somewhat needed; 3 - needed, 4 - very needed.

Table 3
TEN EXPERTS AS EVALUATORS

No	Background	Experience (Year)
Expert 1 [E1]	Works for a state-owned enterprise that manages electricity in Indonesia with a job description as an electricity consultant	4
Expert 2 [E2]	Working in a private company for wood processing and producing Pulp, Paper, Rayon Fiber and Yarn with the job description as production and shipment planner	4
Expert 3 [E3]	Work in a multilevel company that manufactures and assembles electronic products with job descriptions as executive level	7
Expert 4 [E4]	Work in the assembly industry of electronic and automotive components that produce PCB assembly with the position as production planning and inventory control	2
Expert 5 [E5]	Working in the export and import industry of seafood, agriculture, and plantation with a position as a company owner	6
Expert 6 [E6]	Works with national companies in the field of food and beverage processing with job descriptions as production planning and inventory control	3
Expert 7 [E7]	Working in multinational service companies engaged in shopping centers with a position as the marketing coordinator	10
Expert 8 [E8]	Working in a multilevel company in the oil and gas field with a position as Project Planner / Planning Engineer	4
Expert 9 [E9]	Working in a multilevel company in the field of wood processing into Pulp, Viscose, Yield and Paper with the position of manager in Section Head Access Road Maintenance	12
Expert10[E10]	Work as an entrepreneur who has a business unit for processing coconut derivative products with the position as owner	5

Table 4
THE SKILL OF AN INDUSTRIAL INTERNSHIP PROGRAM

No	Industrial Internship Program	Expert	Item
1	an ability to practice "standard operational procedures for employee safety."	[3,4,8]	[PEO1, LO7]
2	an ability to calculate "the key performance index personal on the employee."	[3,8]	[PEO1]
3	an ability to estimate "production capacity and production target."	[6,9]	[PEO2]
4	an ability to illustrate "planning and control systems."	[4,8]	[PEO2, LO5]
5	an ability to estimate "supplier performance."	[3,9]	[PEO2]
6	an ability to calculate "forecasting demand data."	[2,6]	[PEO3, LO4]
7	an ability to apply "7 tools for quality control on the system."	[6,9]	[PEO3, LO5]
8	an ability to illustrate the "scheduling production system."	[6,8]	[LO4, PEO3]
9	an ability to indicate "purchasing goods."	[4,9]	[LO1]
10	an ability to illustrate "the concept of system integration in the company."	[4,6,9]	[LO2]
11	an ability to classify "problem-solving in the company."	[3,8,9]	[LO2, PEO3]
12	an ability to practice "information technology systems to communicate in the company."	[3,6]	[PEO1, LO3]
13	an ability to estimate "management strategies."	[4,9]	[PEO2, LO11]
14	an ability to practice "analytical thinking on integrated systems."	[6,9]	[LO6, LO8, LO9]
15	an ability to practice “teamwork in developing strategy formulation”	[2,3,4,6,8,9]	[LO12]
16	an ability to apply "short course leadership."	[3,6,9]	[PEO2]
17	an ability to apply "projects that use foreign languages."	[2,3,4,8,9]	[LO10]
18	an ability to review "new scientific disciplines in the company."	[4,6,9]	[LO13, PEO3]

Table 5
THE SKILL OF THE ENTREPRENEURSHIP PROGRAM

No	Entrepreneur Program	Expert	Item
1	an ability to compute "market opportunities and challenges."	[5,10]	[PEO1, LO11]
2	an ability to apply to "run a business within a certain period."	[5,7]	[PEO1, LO5]
3	an ability to solve "program to maintain customer satisfaction."	[1,7]	[PEO2, LO8]
4	an ability to indicate "the concept of quality control in business units."	[1,10]	[PEO3]
5	an ability to compute "costing of products or services."	[5,7]	[LO6]
6	an ability to practice "strategy on risk management."	[1,5]	[LO4, LO1]
7	an ability to apply "standard operational procedures to the business."	[1,5,7]	[LO2]
8	an ability to review "design principles to find new ideas."	[5,7]	[LO2, LO13, LO14]
9	an ability to "apply communication skills and information technology applications."	[1,5,7]	[LO3, LO10]
10	an ability to indicate "the quality and quantity of the product."	[5,10]	[PEO1]
11	an ability to apply "scheduling and control of products or services."	[5,10]	[LO7]
12	an ability to choose "human resources and facilities for the company."	[1,7]	[LO9]
13	an ability to practice "correspondence in business communication."	[5,7]	[PEO3, LO12]
14	an ability to practice "upgrading or coaching on the work team."	[1,5]	[LO3]

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